Tanta University Department: **Computers and Control Engineering** **Faculty of Engineering**
Total Marks: 20 Marks

Course Title: **Compilers and Languages** Course Code: CCE3113 3rd year
Date: 28.11.2015 (First term) Allowed time: 1 hrs and 30 minutes

Answer the following questions:

Question No. 1 (8 marks)

1. True or false? Are the following regular expressions exactly equivalent?
(5 marks- 1 mark for each one)

a) x?x*	x*
b) y*|z*	(y|z)*
c) a*b*	(ab)*
d) (P|Q|∈)*	(P|Q)*
e) (0|1)?	0? |1?

Answers: **True, False, False, True, True.**

2. Explain why the grammar below is ambiguous. **(3 marks)**

S → 0A | 1B
A → 0AA | 1S | 1
B → 1BB | 0S | 0

The grammar is ambiguous because we can find strings which have multiple derivations:

S ⇒0A ⇒00AA ⇒001S1 ⇒0011B1 ⇒001101
S ⇒0A ⇒00AA ⇒0011S ⇒00110A ⇒001101

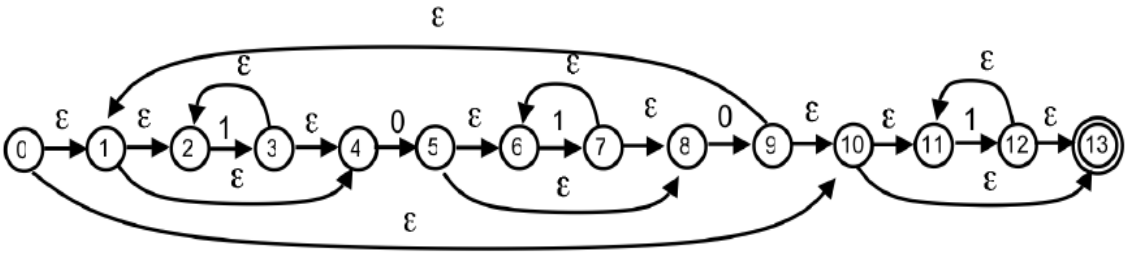
Question No. 2 (6 marks)

1. Considering the alphabet Σ = {0,1}

a) Construct a Non-Deterministic-Finite Automaton (NFA) that is able to recognize the sentences generated by the regular expression (1*01*0)*1*.
b) Convert the NFA to a DFA.
c) Does the string w = "1010" belong to the language generated by this regular expression? Justify.

Answer

(a) The NFA is as shown below



(b)

S0 = ε-closure (0) = {0, 1, 2, 4, 10, 11, 13} – this is a final state because of 13

S2 = ε-closure (S0, 0) = {5, 6, 8}

S1 = ε-closure (S0, 1) = {2, 3, 4, 11, 12, 13} – final state

ε-closure (S1, 0) = {5, 6, 8} = S2

ε-closure (S1, 0) = {2, 3, 4, 11, 12, 13} = S1

ε-closure (S2, 0) = {1, 2, 4, 9, 10, 11, 13} – final state

ε-closure (S2, 1) = {6, 7, 8}

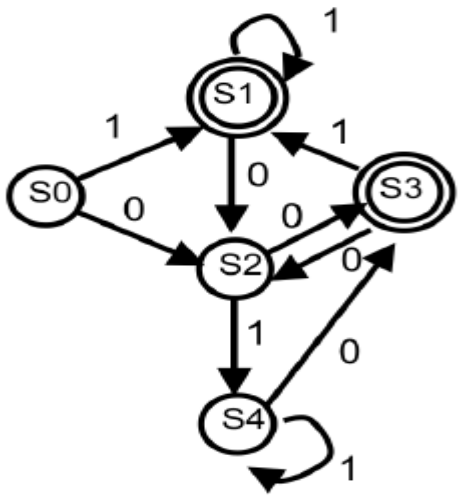
ε-closure (S4, 0) = {1, 2, 4, 9, 10, 11, 13} = S3

ε-closure (S4, 1) = {6, 7, 8} = S4

ε-closure (S3, 0) = {5, 6, 8} = S2

ε-closure (S3, 1) = {2, 3, 4, 11, 12, 13} = S1

This results in the DFA shown below with starting state S0.



(c) Yes, the string w = "1010" belongs to the language generated by this regular expression

S0 $\xrightarrow{1}$ S1 $\xrightarrow{0}$ S2 $\xrightarrow{1}$ S4 $\xrightarrow{0}$ S3.....which is an accepting state

Question No. 3 **(6 marks)**

Given the following grammar G:

S → E

E → T E'

E' → + T E' | ε

T → F T'

T' → * F T' | ε

F → (E) | d

a) Find FIRST and FOLLOW of each non-terminal of the grammar.

N	FIRST(N)	FOLLOW(N)
S	(,d	{}
E	(,d	),$
E'	+	),$
T	(,d	+,),$
T'	*	+,),$
F	(, d	*,+,),$

b) Construct the LL(1) parsing table for the grammar.

N \ Σ	d	+	*	(	)	$
S	E$	err	err	E$	err	err
E	TE'	err	err	TE'	err	err
E'	err	+TE'	err	err	ε	ε
T	FT'	err	err	FT'	err	err
T'	err	ε	*FT'	err	ε	ε
F	F→ d	error	error	F→(E)	error	error

c) Is this grammar LL(1) ? why?

Yes, since there is at most one rule in every cell of the LL(1) table.

Best wishes

Dr. Sherin El Gokhy